

Claims

What is claimed is:

- 5 1. A membrane module for transferring a constituent to or from a fluid, said
 module comprising:
 - a) at least two flat sheet membrane elements, each element having an
 interior portion and an exterior portion; and
 - 10 b) at least one primary manifold that is permanently attached to the
 membrane elements, wherein said primary manifold is in fluid
 connection with the interior portion of the membrane elements.
- 15 2. The membrane module of claim 1, further comprising a space between
 the membrane elements.
- 20 3. The membrane module of claim 2, wherein said primary manifold
 comprises means for delivering gas bubbles to the space between the
 membrane elements.
4. The membrane module of claim 3, wherein said bubbles range in size
 from about 0.5 mm to about 50 mm.
- 25 5. The membrane module of claim 4, wherein said bubbles range in size
 from about 1 mm to about 12 mm.
6. The membrane module of claim 2, wherein said primary manifold
 comprises at least one fluid flow channel that carries a fluid to or from
 the interior portion of the membrane elements.

7. The membrane module of claim 6, wherein said primary manifold further comprises a second flow channel that carries a fluid for delivery to the space between the membrane elements.

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8. The membrane module of claim 7, wherein said fluid comprises a gas.

9. The membrane module of claim 3, wherein the primary manifold comprises perforations for receiving gas bubbles dispensed from below the membrane module and delivering said bubbles to the space between the membrane elements.

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10. The membrane module of claim 9, wherein the primary manifold further comprises V-shaped or angled channels for collecting fine bubbles dispensed from below the membrane module and combining to form larger bubbles for delivery to the space between the membrane elements.

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11. The membrane module of claim 3, said module comprising a second primary manifold that is positioned at the opposite end of the membrane elements, wherein said second primary manifold is in fluid connection with the interior portion of the membrane elements.

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12. The membrane module of claim 11, wherein the second primary manifold is adapted to disperse the gas bubbles that are delivered between the membrane elements, thereby preventing said gas bubbles from collecting within said module.

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13. The membrane module of claim 12, wherein the second primary manifold is perforated to allow the gas bubbles to disperse.

14. The membrane modules of claim 12, wherein the second primary manifold is beveled or angled to allow the gas bubbles to disperse.

5 15. The membrane module of claim 1, wherein said module further comprises a spacer that separates adjacent flat sheet elements.

16. The membrane module of claim 1, wherein said module further comprises at least one secondary manifold in fluid connection with at
10 least one primary manifold.

17. The membrane module of claim 6, wherein said module further comprises a secondary manifold in fluid connection with said fluid flow channel of said primary manifold.

15 18. The membrane module of claim 1, wherein tension is applied to said membrane elements to aid in maintaining the spacing of said membrane elements.

20 19. A membrane cassette comprising at least two of the membrane modules of claim 1.

20. The membrane cassette of claim 19 further comprising a frame surrounding or supporting said membrane modules.

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